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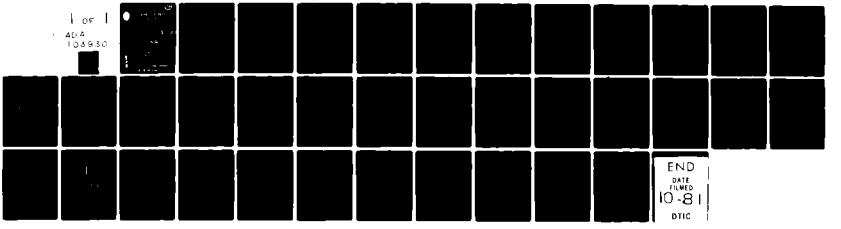

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Appetitive and Aversive Reinforcement Schedule Effects on Team Performance

TECHNICAL REPORT #2

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Three volunteers lived for six successive days in a laboratory programmed for continuous residence. When work on a multiple task performance battery had the effect of preventing a reduction in accumulated team earnings, all subjects complained, one subject stopped working, and another subject's productivity declined. When identical work had the effect of incrementing team earnings, by-products of aversive control were absent.

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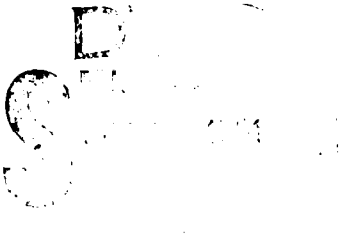
A recent series of experiments (Brady and Emurian, 1979) undertaken with 3-person teams living for 10-12 days within a laboratory facility has identified a set of conditions whose impact on team members included reactions similar to those observed during the first half of the third Skylab mission (16 November 1973 to 8 February 1974). The public visibility of these astronauts along with their reported reactions and adjustments throughout this important long-duration mission afforded the opportunity to scrutinize an exemplar of an operational team and to demonstrate the relevance of basic research endeavors in the development of team performance effectiveness technology. Such a technology could potentially impact upon the human engineering aspects of settings having coordinated performance demands which are similar in scope and/or complexity to those programmed aboard Skylab (cf, aquanauts aboard Tektite II, as described in Miller, Van Derwalker, and Waller, 1971; teams within tactical flag command centers, CICs, nuclear submarine attack centers, ASW attack centers, and carrier and shore-based air traffic control centers as indicated in Thorndyke and Weiner, 1980).

The flight crew aboard the third Skylab mission, in contrast to crews manning the two preceding missions, exhibited unprecedented and unanticipated irritability and recalcitrance for at least the first half of the mission. In particular, this third crew was described as lethargic, negative and unaccountably irritable, and a reprimand related to an unreported vomiting episode early in the flight was followed by terse and querulous conversations with the ground. Indeed, the three crew members seemed to be overtly hostile to Skylab and Mission Control. These



reactions culminated in a sitdown strike about midway through the 84-day mission when the crew members stopped working for a day and did what they pleased (Cooper, 1976).

That these astronauts were subjected to verbal reprimands from ground control when their behavior did not meet expectations clearly suggests that aversive consequences were prominently involved in the maintenance of performances required of these individuals in the course of their daily and highly regimented activities aboard the space platform (Weick, 1977). Additionally, the phrase "forcing them" was reported to characterize the manner in which Mission Control initially maintained the astronauts' pace of work to accomplish such activities (Cooper, 1976, p. 167). Accordingly, our previous experiments were undertaken to develop a laboratory model for the identification and analysis of functionally similar motivational conditions which may provoke undesirable responses by inhabitants and operators of such environments (e.g., sea and space platforms). These experiments involved comparisons of effects of two motivational conditions (i.e., appetitive and aversive reinforcement) maintaining work-task performance on individual and interpersonal adjustment and on team performance productivity. Under an appetitive condition, work performances were maintained by monetary earnings, and under an aversive condition, identical work performances were maintained by avoidance of loss of accumulated earnings. Such incentive conditions were chosen for investigation because of the evidence linking (1) hostility and aggression with aversive control (e.g., Hutchinson, 1976) and (2) dissipation of hostility to cooperative goals pursued under appetitive circumstances

(e.g., Sherif, 1967; Deutsch, 1963). In the course of developing such a laboratory model, we have previously studied three 3-person teams working under appetitive (AP) and aversive (AV) incentive conditions in the following order and number of successive days, respectively: AP-AV-AP (4,4,2), AP-AV-AP-AV (3,3,3,3) and AP-AV-AP (3,6,3).

When study participants' work was programmed according to the aversive reinforcement schedule (i.e., avoidance of monetary loss), negative ratings of the behavioral program and of the experimenters were significantly higher during avoidance days in comparison to such ratings during appetitive days, and liberal unsavory invective was endured by research supervisors. Indeed, an extreme instance of such hostility was exemplified by one participant who deliberately and openly damaged some of the laboratory hardware. Additionally, the total number of work units (i.e., one unit=100 arithmetic problems, 1000 lever operations, and physical exercise) completed each day by a team was more evenly distributed among the three participants during avoidance days than during corresponding appetitive days. In this latter regard, in a team where one member's work output was consistently somewhat less than the other two members, negative interpersonal ratings were directed toward the "low-productivity" person during the aversive condition, and he was isolated from social activities during the final days of the study. Finally, most team participants reported dysphoric mood under the avoidance work condition.

In contrast to such effects observed under the avoidance schedule, when identical work was programmed according to a cooperative appetitive

reinforcement schedule, (i.e., monetary earnings), team members were free from disruptive by-products of the aversive schedule even when extraordinary work productivity was observed. These findings together suggest that the functional properties (i.e., consequences) associated with work were far more significant to the team members' well-being than were the topographical properties (i.e., the behaviors required to perform the work).

The most recent experiment completed within this series is even more revealing in that some team members undertook a sitdown strike with respect to work, after reacting for several days in ways which appear parallel to crew reactions preceding the strike that occurred aboard the third Skylab mission. This systematic replication of the previous experiments involved the introduction of a multiple task performance battery determining work performance within a duty station which could be occupied by subjects one at a time on a self-determined rotational basis, and it accordingly simulated situations requiring a team to be continuously vigilant with respect to critical mission demands. Thus, the coordination required of team participants to accomplish mission objectives (i.e., maximum performance productivity) was operationalized in terms of the synchrony required for sequential performance episodes across successive 24-hour observational intervals (Thorndyke and Weiner, 1980, p. 4). These procedural innovations were intended (1) to extend the analysis of reinforcement effects to a somewhat different set of experimental conditions and thus (2) to demonstrate the reliability and generality of previous results.

METHOD

Subjects. In response to a recruitment notice placed in a local newspaper, three male respondents were accepted for participation in the research on the basis of psychological evaluation, educational background, and availability. Two subjects were college students (both ages 18), and the third subject was a college graduate (age 34) who was a gainfully independent entrepreneur. No subject showed psychological disorder or aberrant personality style as evidenced by the results of the Minnesota Multiphasic Personality Inventory and the 16 Personality Factors Inventory, respectively. Subjects were familiarized with the operational features of the laboratory, with the experimental methodology, and with the performance task during several daily sessions preceding the experiment; informed consent was obtained. Remuneration was a function of work-task productivity and accuracy, and parameters were chosen such that each subject could earn approximately $25 per day for completing the experiment.

Apparatus. The programmed environment was composed of three 2.6 by 3.4 by 2.4 m private rooms, a 4.3 by 6.7 by 2.7 m recreation room, a 2.6 by 4.1 by 2.7 m duty station, and a 2.3 by 7.9 by 2.4 m hall joining the rooms. The characteristics of this laboratory environment are described in detail elsewhere (Bigelow, Emurian, and Brady, 1975; Brady, Bigelow, Emurian, and Williams, 1975).

Behavioral program. Figure 1 presents a diagrammatic representation of the behavioral program governing the sequential and contingent relationships of activities employed throughout the experiment. Each box

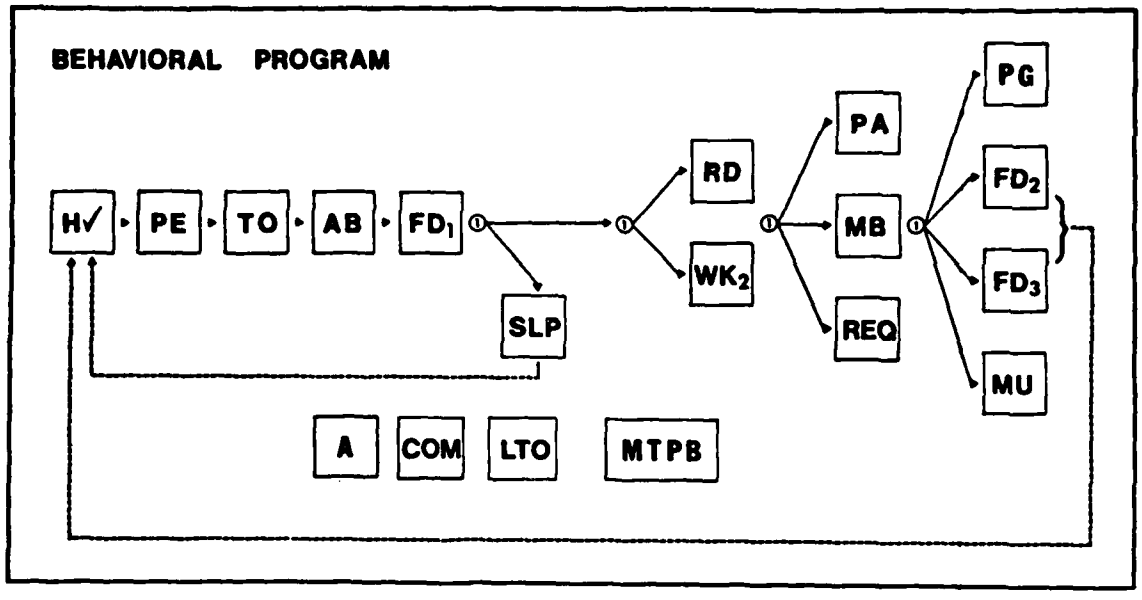


Figure 1. A diagrammatic representation of the behavioral program governing the sequential and contingent relationships of activities employed throughout the experiment.

within the diagram represents a distinct behavioral unit and response requirement. Subjects progressed through the program sequentially from left to right. This progression involved program branches composed of a fixed activity sequence and optional activity sequences. Regardless of the sequence selected, the diagram indicates that all behavioral units were scheduled on a contingent basis such that access to a succeeding activity demanded satisfaction of the requirements for the preceding unit.

Beginning at the far left, the fixed activity sequence was composed of all activities between and including Health Check (H /) and Food One (FD1). The Health Check activity required the subject to determine his temperature, pulse, and weight, and to complete several subjective status questionnaires. He then completed the following activities in the order displayed: Physical Exercise (PE), requiring 500 correct responses on an automated exercise task; Toilet Operations (TO), providing access to the private room bathroom and drawers containing towels, toiletries, and a vacuum cleaner; Autogenic Behavior (AB), in which the subject followed taped relaxation instructions; and Food One (FD1), in which the subject was permitted to select two items from a presented list of 10 "light" foods such as coffee, tea, soup, cereal, etc.

When Food One was completed, the subject was eligible to select <u>one</u> of the following three activities: Reading (RD), providing at least 30-minutes' access to books contained within a drawer; Work Two (WK2), in which the subject completed in private various problems, experiments, or assembly projects presented in a drawer; and Sleep (SLP), providing access

to the bed for an unlimited time period of at least 30 minutes. If the subject selected Sleep, he was required to return to the Health Check activity and the fixed activity sequence at the completion of Sleep. This minimum recycling sequence was designed to maintain and assess the subject's health if he were otherwise indisposed to engage in the broader selection of opportunities.

The optional activity sequence began with the choice of one of the following two activities: Reading (RD), providing at least 30-minutes' access to books, or Work Two (WK2), in which the subject completed various word games, experiments, or assembly projects. When the selected activity was completed, the subject was eligible to select one of the following three activities: Puzzle Assembly (PA), requiring the subject to assemble a jigsaw puzzle presented in a drawer; Manual Behavior (MB), providing at least 30-minutes' access to art supplies contained in a drawer; and Requisition (REQ), allowing the subject to press a lever to earn at least one but not more than 20 points exchangeable for treats such as soft drinks and pastries. On completion of the selected activity, the subject was eligible to select one of the following four activities: Private Games (PG), allowing at least 30-minutes' access to an assortment of solitary games within a drawer; Food Two (FD2), requiring at least 30 minutes and providing the subject with a major meal to eat within his private room; Food Three (FD3), providing at least 30 minutes in the recreation room by one, two, or three subjects to eat a major meal and to play games; and Music (MU), allowing the subject to press a lever to earn a cassette tape that could be played at any time. Once a subject had completed his choice

among those four activities, he returned to Health Check and resumed the fixed activity sequence, indicated by the dotted line. The optional activity sequence allowed the subject flexibility in the selection and arrangement of activities, both individual and social.

At the bottom of the diagram are four activities with more general rules. The Limited Toilet Operations (LTO) activity, which provided access to the bathroom, could be selected at any time. The Audit (A) activity could also be selected at any time, and it provided the subject with all subjects' work productivity scores during the current day. The Communication (COM) activity allowed access to the intercom for intersubject communications. A subject was permitted to use the intercom to initiate or to answer a communication only if he were between any two program activities. Although the Communication activity was available between any activities, an actual conversation required at least two subjects' simultaneous presence within the Communication activity. Conversing subjects, however, whether in pairs or all three at once, could be located at different sequential positions within the behavioral program. For example, a Communication and conversation might have occurred when one subject was between Autogenic Behavior and Food One, and another subject was between Manual Behavior and the last column of activities, and so on. The Multiple Task Performance Battery (MTPB) activity, to be described below, provided access to the duty station, and it could be selected between any two activities in the behavioral program.

No communications were exchanged between experimenters and subjects other than an occasional message presented on subjects' cathode ray display screens to inform subjects of an equipment problem or to clarify a misunderstanding of the protocol.

Each activity within the behavioral program had a 12.7 by 20.3 cm metal card portraying an abbreviated activity notation that a subject displayed in his private room whenever that activity was selected. When an activity card was displayed, environmental events and response requirements related to that activity were in effect.

A manual of instructions detailing the program and use of environmental resources was contained in each room of the environment. Instructions between conditions differed only with respect to the rules by which remuneration for participation was accumulated or maintained. An example of a subject's instructional manual, health assessment questionnaires, and procedural details associated with the various activities is presented elsewhere (Emurian, Emurian, Schmier and Brady, 1979).

Performance task. A Multiple Task Performance Battery (MTPB) was used as the major performance assessment tool throughout the experiment. Figure 2 presents a photograph of the console on which the performance tasks were presented on a cathode ray tube display terminal. The battery was composed of the following five task components which were presented concurrently to an operator: (1) blinking lights, providing a measure of watchkeeping, (2) warning lights, providing a measure of vigilance, (3) probability

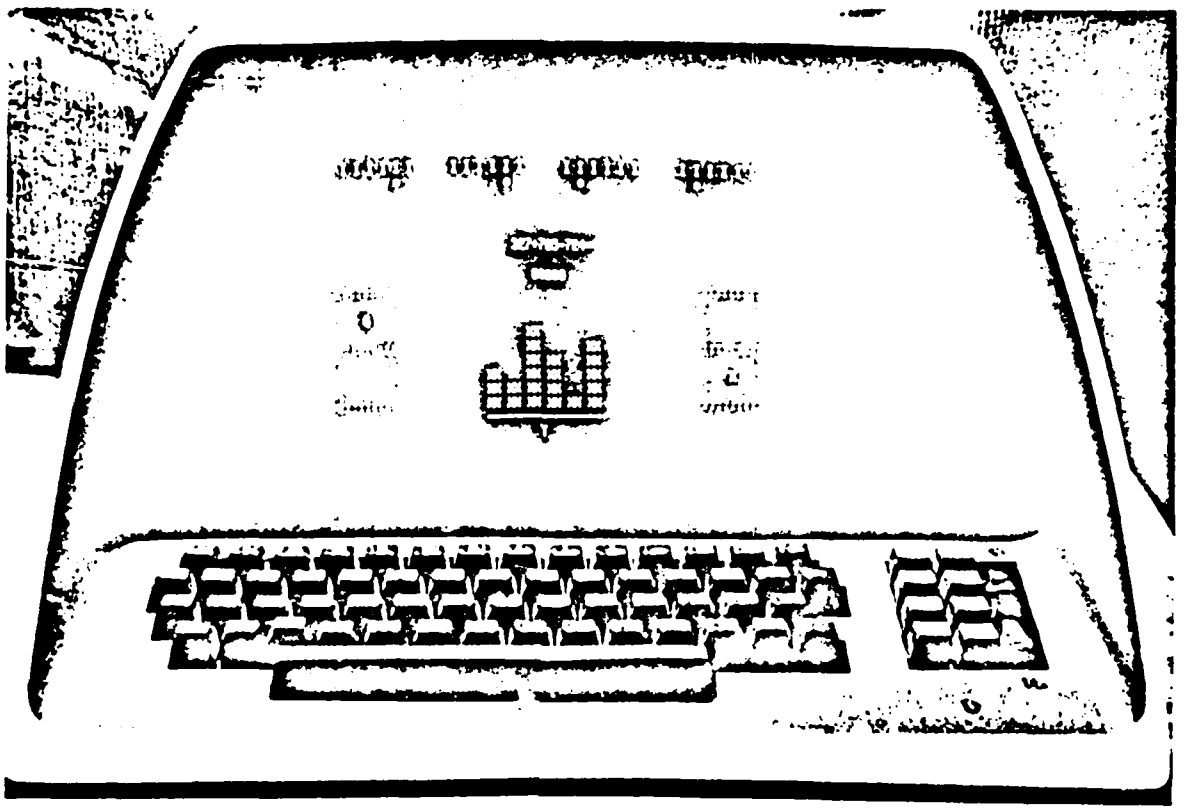


Figure 2. A photograph of the console on which the performance tasks were presented on a cathode ray tube display terminal.

monitoring, providing a measure of attentive functions, (4) target identification, providing a measure of sensory-perceptual functions, and (5) arithmetic operations, providing a measure of computational functions. Accurate responses produced points (1 point=1 cent) which were presented on the screen as they were accumulated. The parameters associated with the tasks were chosen so that an operator with 5-10 hours of practice could accumulate 500-600 points per hour, and the upper limit of performance was approximately 750 points per hour. A comprehensive description of this battery is presented by Emurian (1978), and the rationale for this "synthetic work" methodology is presented by Morgan and Alluisi (1972).

Procedure. Subjects followed the behavioral program continuously throughout the 6-day experiment. Additionally, the rules by which remuneration for participation was accumulated or maintained were varied to assess the effects of appetitive and aversive motivational conditions on behavior.

Under an appetitive motivational condition, any team member's accurate responding on the MTPB produced points resulting in corresponding monetary deposits in a team account that was to be divided evenly among members at the conclusion of the experiment. Under an aversive motivational condition, the team was assigned a point criterion to be completed during the next twenty-four hours. This criterion was based upon the daily performance productivity of the team observed during the immediately preceding appetitive condition. No money was deposited in the team account during the aversive condition, and if the criterion were not reached on a

given aversive day, the team account was reduced by the number of points falling below the criterion.

The appetitive (AP) and aversive (AV) conditions were in effect in the following order and number of days, respectively: (AP, AV, AP: 2, 3, 1). Subjects were informed at the beginnning of each day about which condition would be in effect for the next 24 hours.

Pairs of research assistants monitored the experimental environment continuously with audio and video equipment located, with the subjects' awareness, in each room of the environment. When a subject displayed an activity card, an assistant recorded its time of presentation by writing the activity abbreviation on a prepared data form divided into 30 1-minute segments for each subject and labeled according to the time of day. Assistants also manually activated electromechanical devices and minicomputers controlling resources and tasks associated with respective activities, and they delivered materials to the subjects through two-way drawers, when necessary.

RESULTS

Between- and within-subjects' differences were observed in points earned per day on the Multiple Task Performance Battery. These data are shown in Table 1 which presents total points earned by each team member across successive days of the experiment along with the criterion assigned to the team during aversive days. Variability in productivity among team members is evident on Day 1 when Subject 3 contributed only 19.8% of the

TABLE 1

TOTAL MTPB POINTS PER DAY

Successive Days

	Appetitive Days No Criterion		Aversive Days Criterion=12700			Appetitive Day No Criterion
Subject	1	2	3	4	5	6
1	4554	4221	4388	4627	0	5648
2	3927	4381	4437	4810	2450	5023
3	2000	4126	3966	3207	3755	4487

total points earned on that day, in comparison to 41.2% and 40.0% for Subjects 1 and 2, respectively.

Subjects initially adopted an orderly and alternating sequence of occupying the duty station to operate the MTPB, with each work episode lasting approximately 4 hours. These data are presented in Figure 3 which presents time of day spent working for all subjects across successive days of the experiment. During the first three days of the study, there was almost perfect day-to-day agreement with respect to the time of day when each subject worked. On Day 4, the second aversive day, however, Subjects 2 and 3 switched positions from the previously established pattern, with Subject 3 now working later in the day in comparison to his work times during the preceding appetitive days. On Day 5, Subject 1 failed to work, and Subject 2 worked on only one occasion. On Day 6, the final appetitive day of the experiment, the disruptive effects observed on Day 5 were reversed, and subjects adopted an alternating work sequence identical to that observed on Day 4. Finally, only Subject 1 maintained a consistent time of day when he worked, with the exception of Day 5, across successive days of the experiment.

The comparatively few work episodes which occurred on Day 5 of the experiment, as shown in Figure 3, were related to the following incident which occurred on the previous day. On Day 4, the second day of the aversive condition, a crisis occurred within the team which not only resulted in withdrawal from work by a participant but also compromised the team's ability to complete the "mission" (i.e., satisfaction of the

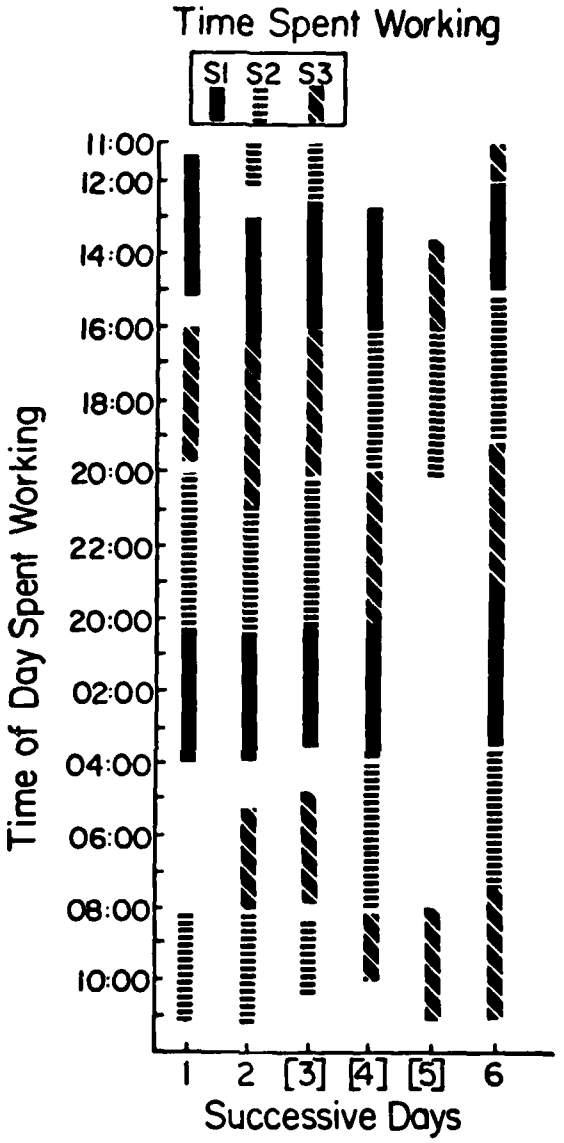


Figure 3. Time of day spent working for all subjects across successive days of the experiment. Days which are bracketed (i.e., 3, 4 and 5) are aversive days; other days are appetitive days.

assigned daily work criterion). On that second day of the aversive condition, Subject 3 fell behind in his share of work, as agreed upon by team participants, and he caused the criterion to be missed by 56 points. Unlike a high-productivity participant's tolerance of variation in work output during the appetitive condition (e.g., Day 1), this team member (Subject 1) became openly hostile at this relatively trivial shortcoming, and he reprimanded Subject 3 during an intercom conversation at the end of Day 4. Significantly, Subject 1 refused to perform any further work during the aversive condition, whose duration was not known by the team, and on Day 5 the team lost heavily in potential earnings as a result, at least in part, of insufficient personnel to operate the performance battery on an efficient basis. Of at least equal importance was the fact that Subject 1's emotional outburst and his refusal to work was, in part, paralleled by Subject 2 who showed a markedly diminished output of work on Day 5. Neither Subject 2 nor Subject 3 showed a compensatory increase in work productivity on Day 5 that may have otherwise satisfied the criterion which was missed on that day by 6495 points.

When the appetitive condition was reintroduced on Day 6, Subjects 1 and 2 again contributed to work output, and, indeed, all subjects showed the greatest daily point accumulations on that final day of the experiment.

Wake-sleep cycles did not fall into stable and orderly patterns across the course of the experiment. These data are shown in Figure 4 which presents time of day spent sleeping for all subjects across successive days of the experiment. Sleep episodes typically were less than 8 hours in

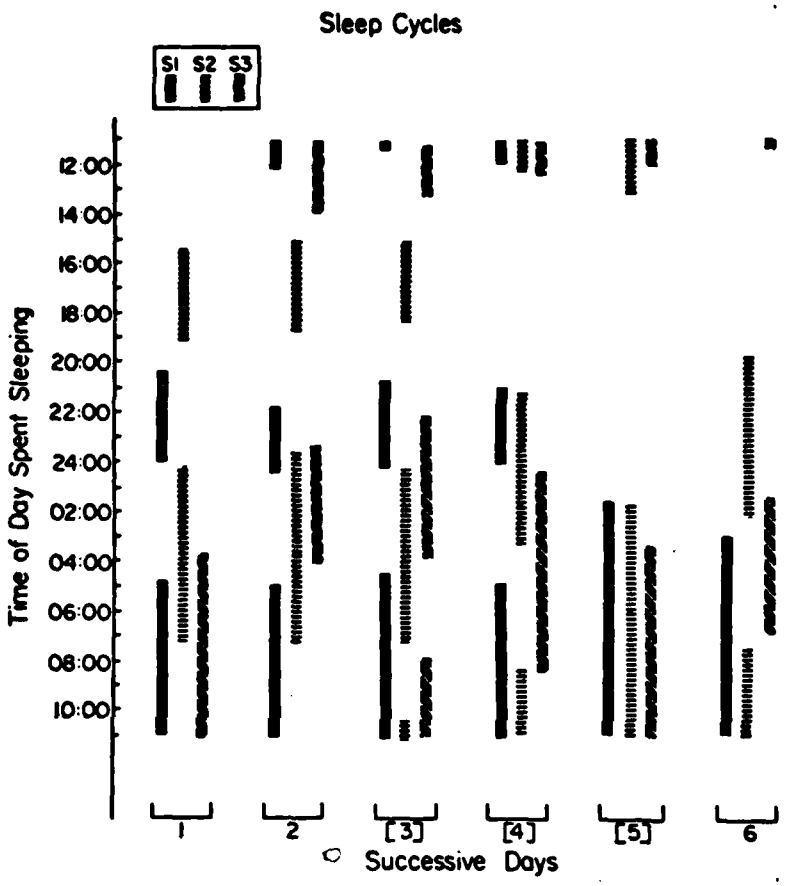


Figure 4. Time of day spent sleeping for all subjects across successive days of the experiment. Days which are bracketed (i.e., 3, 4 and 5) are aversive days; other days are appetitive days.

duration, and more than one sleep period per day occurred for most subjects. Subject 1, however, adopted brief but regular sleep periods for the first four days of the experiment, in comparison to such sleep periods exhibited by Subjects 2 and 3. Subject 1 abandoned his previously established patterns on Day 5, the day when he refused to work, and he did not return to his earlier sleep cycles on the subsequent final day of the experiment. These effects are attributable, at least in part, to the style of alternating work that the subjects initially adopted to occupy the duty station around the clock. Perhaps more importantly, these data suggest that the structured approach to both work times and sleep cycles demonstrated during the first four days of the experiment by Subject 1 could not be similarly sustained by remaining participants across the course of the experiment.

The disruption in team cohesion during the aversive condition was also reflected in the way the team members reported feeling about one another. During each Health Check activity in the behavioral program, each team member completed a 4-point scale reflecting degree of irritation (1=none to 4=extreme) with the other two members. Table 2 presents mean ratings of such irritation for all subject-paired combinations across days. For all subjects, the greatest irritation with another member occurred during the aversive condition (Subject 1 toward Subject 3 on Days 3 and 5, Subject 2 toward Subject 3 on Day 3, and Subject 3 toward Subject 1 on Day 5).

The expressed opinions and emotional attitudes of the team directed to the behavioral program and to the experimenters differed between conditions

TABLE 2

MEAN INTERPERSONAL RATINGS PER DAY

		Successive Days					
		Appetitive Days		Aversive Days			Appetitive Day
Subject Rating	Subject Rated	1	2	3	4	5	6
1	2	1.3	1.5	1.0	1.0	1.0	1.0
	3	1.3	2.0	2.3	2.0	2.6	2.0
2	1	1.0	1.0	1.0	1.0	1.0	1.0
	3	1.0	1.0	2.3	1.0	1.0	1.0
3	1	1.0	1.0	1.0	1.0	2.3	1.5
	2	1.3	1.5	1.0	1.0	1.0	1.0

as assessed from similar 4-point scales. Figures 5 and 6 present mean ratings on these scales for all subjects across days. With respect to the behavioral program, all team members expressed increasing irritation with the program over successive aversive days in contrast to no expressed irritation during the preceding and succeeding appetitive days. With respect to the experimenters, Subject 1 (the team member who did not work on Day 5) reported most irritation during the aversive condition.

With respect to the intrapersonal effects of the incentive conditions, all subjects reported dysphoric mood during the avoidance days in comparison to the preceding appetitive days. These data are presented in Table 3 which shows mean ratings on the Depression factor of the Lorr's Mood Scale (Lorr, Daston and Smith, 1967), which was administered during each Health Check activity, for all subjects across successive days of the experiment. Subjects 1 and 2 showed the highest Depression rating on Day 5 of the experiment which was the final day of the avoidance condition. Importantly, these elevated ratings were associated with cessation of work by Subject 1 and diminished work by Subject 2. Additionally, both Subjects 1 and 2 showed a comparative reduction in Depression ratings on the next and final appetitive day (i.e., Day 6) of the experiment despite the increases in MTPB productivity which were observed. Subject 3, the team participant whose daily performance productivity was consistently somewhat less than the other team members, showed the highest Depression rating on Day 6, the final appetitive day of the experiment when he demonstrated his greatest MTPB point potential. These data, then, suggest that performance productivity itself need not be a major source of dysphoric mood (i.e.,

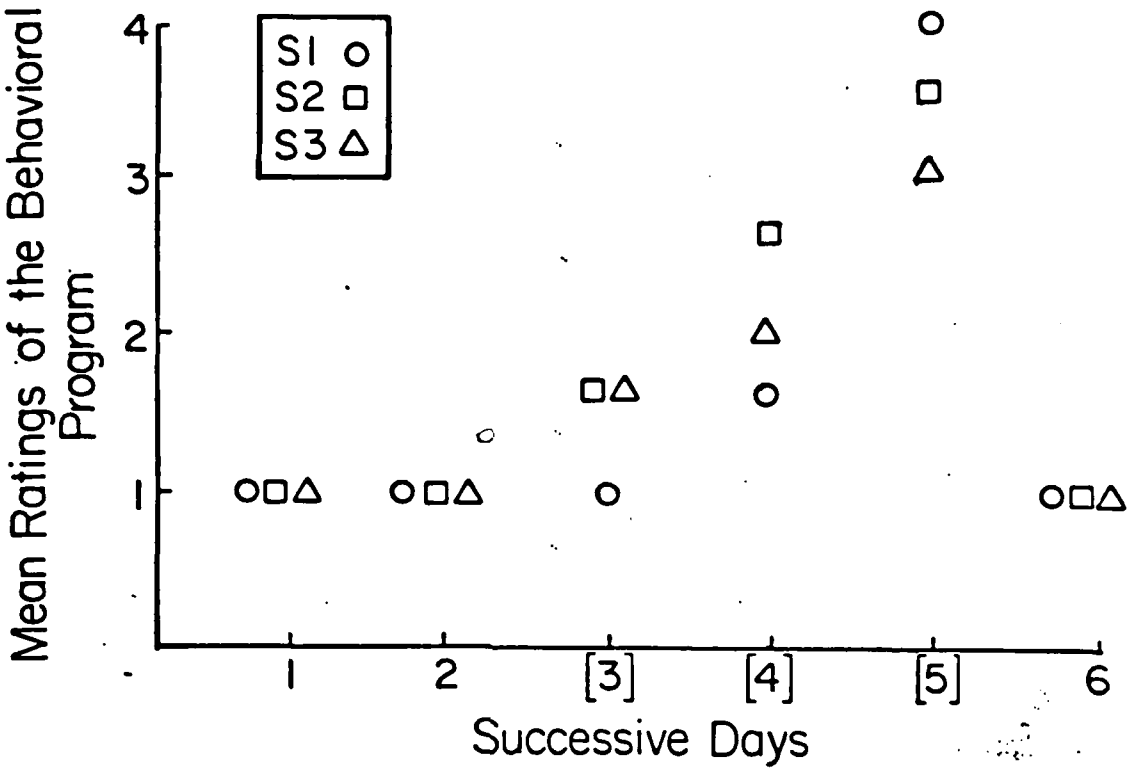


Figure 5. Mean ratings of the behavioral program, on a 4-point scale where 1 = not at all bothered by the program and 4 = extremely bothered, for all subjects across successive days of the experiment. Ratings were obtained during health and status assessments which occurred several times each day. Days which are bracketed (i.e., 3, 4 and 5) are aversive days; other days are appetitive days.

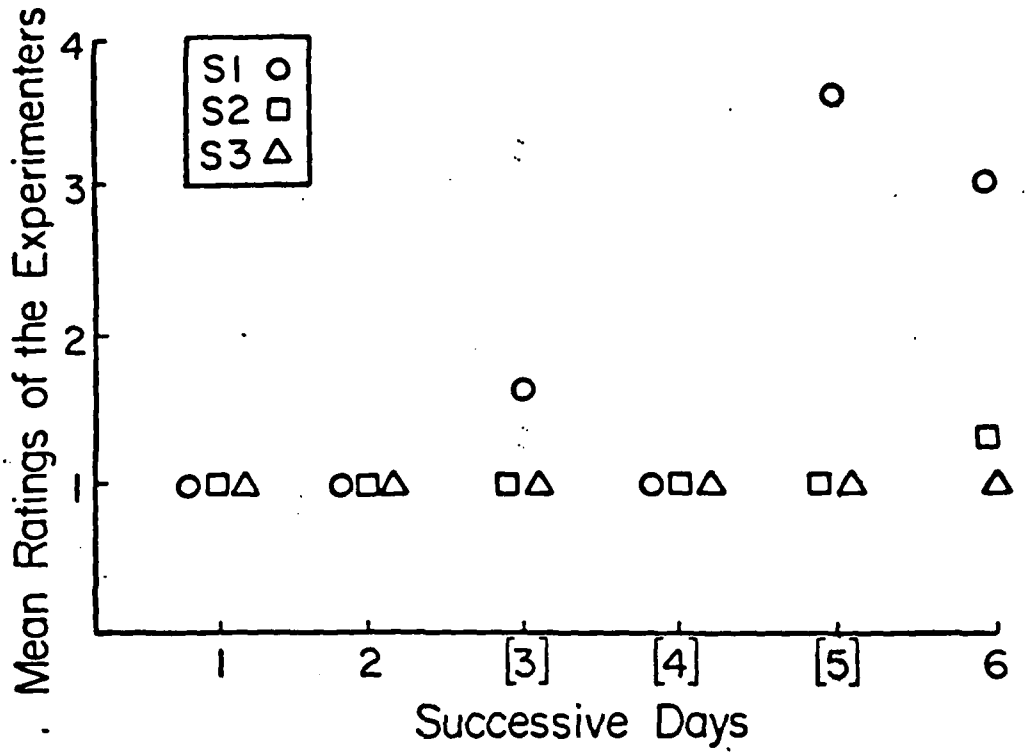


Figure 6. Mean ratings of the experimenters, on a 4-point scale where 1 = not at all bothered by the experimenters and 4 = extremely bothered, for all subjects across successive days of the experiment. Ratings were obtained during health and status assessments which occurred several times each day. Days which are bracketed (i.e., 3, 4 and 5) are aversive days; other days are appetitive days.

TABLE 3

MEAN DEPRESSION RATINGS PER DAY

	Successive Days					
	Appetitive Days		Aversive Days			Appetitive Day
Subject	1	2	3	4	5	6
1	8.7	9.0	8.7	8.0	12.6	8.5
2	9.5	10.3	13.0	13.3	14.0	10.3
3	8.3	8.3	9.0	8.8	9.7	10.0

"low morale") by such team participants since two of the three team members were most dysphoric during days when their work productivity was minimal. The consequence of such reduced work, however, was the introduction of an aversive event (i.e., monetary loss) which was occasioned, at least in part, by the presence of a team participant (i.e., Subject 3) who was unable or unwilling to adopt the performance norms of the majority of the team members.

Only two social episodes occurred during the course of the 6-day experiment. Subjects 2 and 3 engaged in a 108-minute social episode on Day 4, the second day of the aversive condition, and Subjects 1 and 2 engaged in a 244-minute social episode on Day 5, the third and final day of the aversive condition. This latter episode occurred on the day when Subject 1 refrained from working and Subject 2 reduced his customary productivity. The fact that no triadic social episode occurred perhaps indicates the failure or inability of this group to develop, without external influences, an early cohesiveness which may have otherwise prevented the performance decrements and interpersonal confrontations which emerged during the avoidance days of the experiment.

The behavioral effects observed in this experiment were related to hormonal levels obtained from total urine volumes collected throughout the course of the study. Figure 7, for example, shows a strong overall relationship for these three subjects between mean individual MTPB productivity and mean daily cortisol levels determined by radioimmunoassay (Mougey, 1978). A direct relationship is evident between mean MTPB points

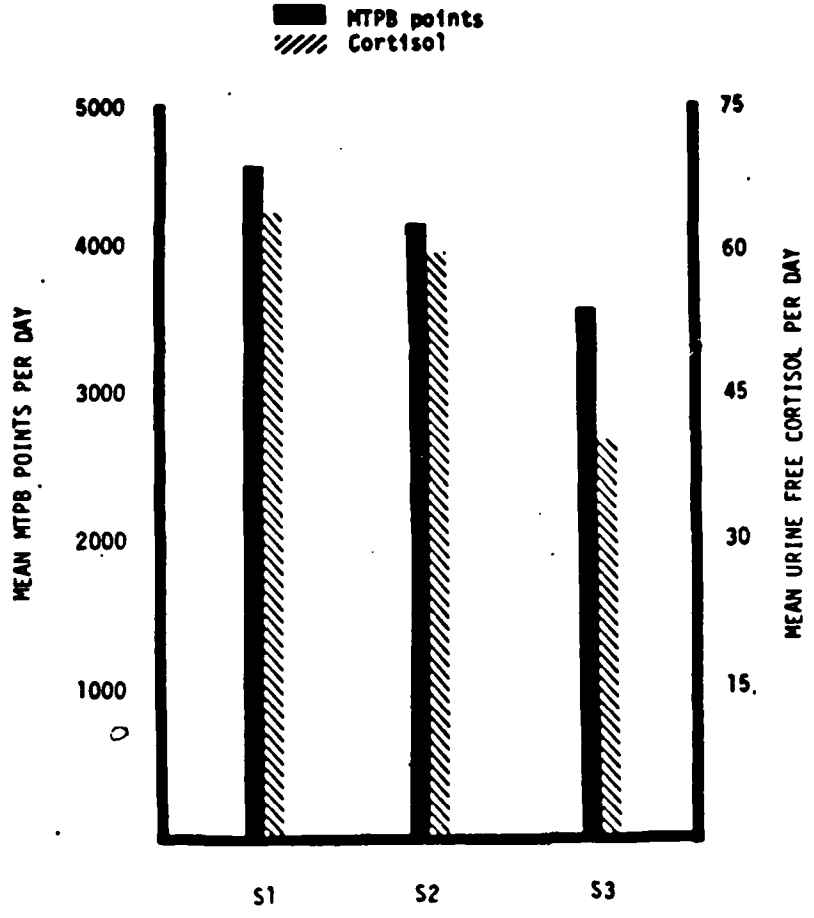


Figure 7. The relationship for the three subjects between individual MTPB productivity and mean daily cortisol levels determined by radioimmunoassay.

per day and mean micrograms of urine free cortisol per day with the team member showing the highest average MTPB productivity (Subject 1, omitting Day 5) also showing the highest average cortisol level. Conversely, the team member showing the lowest average MTPB productivity (Subject 3) also showed the lowest average cortisol level. Significantly, Subject 1 was the high-productivity participant who refused to work on Day 5 of the experiment, and Subject 3 was the low-productivity participant who failed to reach the criterion on Day 4 of the experiment. These observations together suggest that sustained high-productivity along with prolonged performance accuracy on a demanding task may render an individual vulnerable to disruptive emotional reactions such as those provoked by the aversive phase of the study. Most importantly perhaps, these results emphasize the contributions of a multi-dimensional analysis of individual and team performance effectiveness, and they clearly demonstrate the utility of programmed environment methods and procedures in assessing the broad range of dependent measures which encompass such an analysis.

DISCUSSION

The results of the present experiment show clearly that changing the consequences of performing a task from an appetitive to an aversive reinforcement schedule produced by-products of aversive control which involved verbal performances (e.g., program assessment ratings), interpersonal performances (e.g., verbal confrontation and intersubject ratings), work performances (e.g., diminished productivity), and team morale (e.g., dysphoric mood). When the work incentive was changed from

aversive to appetitive, such deleterious by-products were, for the most part, eliminated despite the team's several-day history of working under aversive control. These results confirm and systematically replicate the outcomes of previous studies of aversive reinforcement effects under programmed laboratory conditions (Brady and Emurian, 1979), and they suggest that under such conditions where performance requirements are continuous and challenging, a team may fail to complete its mission (i.e., completion of assigned work).

Although the effects produced by the avoidance schedule were evidenced within the context of a single reversal (i.e., A-B-A) experimental design, the magnitude and rapidity of the changes which occurred on Day 6 (i.e., the final appetitive day), in contrast to effects observed during prior avoidance days, suggest control by that schedule rather than control attributable to the passage of time within the laboratory environment or to other processes. In comparison to very long-duration studies employing multiple reversals with a large sample of subjects, such a design was chosen as a compromise procedure which could nevertheless demonstrate effects and yield meaningful information with acceptable scientific rigor, given the realistic constraints of undertaking such research with competent human volunteer participants. Indeed, in a previous study which ended with an aversive reinforcement condition still in effect (i.e., AP-AV-AP-AV), the displeasure of the subjects was sufficiently intense to preclude further experimental analyses with such an identical multiple reversal of the incentive schedules.

The present experiment was the fourth study in a series of systematic replications in which control by the avoidance incentive schedule was demonstrated by affirming the consequent (Sidman, 1960), in which case each successive replication incrementally contributes to an understanding of effects which can be reliably attributable to the antecedent condition (i.e., the avoidance schedule). The generality of the behavioral processes is assured by showing similar effects across a broad range of circumstances (e.g., subjects, duration of experiment, work tasks, order of experimental conditions, etc). Although all members within the teams studied showed at least some identical reactions to the avoidance schedule (e.g., spoken and written complaints), the interpersonal confrontations were most prominent within those teams having an assertive member who was at least unappreciative, if not openly intolerant, of variability in work productivity during the avoidance condition. The extent to which such an individual may be identified prior to a mission must, of course, await clarification by further experimental analysis of avoidance schedules with particular emphasis on their interactions with subject variables. It must be emphasized, however, that successful operation and survival of exotic habitats, including combat situations, may well depend critically upon the presence of individuals with different skills, capabilities and personalities. Under such conditions where intersubject variability is inevitable, the potential for the contributions of a behavioral technology which minimizes interpersonal and performance disruption seems more than obvious.

When a team is assigned a mission whose accomplishment requires its members to approach the limits of human energy and endurance on a daily basis for weeks at a time, it seems hardly surprising that such a team may become vulnerable to recalcitrance in the face of unreasonable demands to perform. It was the case, however, that the Skylab astronauts were expected to perform in such a fashion as a "nonmedical duty" (Weick, 1977), and based upon the reported reactions of the crew to this duty, it is not unreasonable to propose that an aversive incentive schedule was instrumental in motivating the performance of such work assignments. The present laboratory research complements such observations by showing that even when the limits of human capabilities are not reached within the course of daily work, by-products of aversive contingencies can emerge with sufficient intensity to compromise a team's ability to complete a given "mission".

In this latter regard, the earliest indication of subjects' sensitivity to the presence of an aversive reinforcement schedule was in the form of verbal responses. Systematic written reports from the subjects reflected complaints about the aversive contingency when it was first introduced on Day 3 of the experiment, and such expressions of discontent increased in magnitude across the 3-day aversive interval. These written responses, along with anecdotally observed complaints about the aversive contingency, are categorized by their functional properties as a mand (Skinner, 1957), and they emerge because similar responses have been effective historically in eliminating aversive events from one's environment. These data, then, suggest the importance of frequent and

systematic assessment of subjects' descriptions of their environment so that the necessary adjustments may be undertaken to avoid a crisis situation such as occurred on Day 5 of the experiment. Finally, the fact that frequent and vociferous verbal complaints were also observed aboard the last Skylab mission is further evidence of that crew's sensitivity to the presence of aversive reinforcement conditions, at least during the first half of the mission (cf SEALAB aquanauts).

Requirements for high levels of human performance and adjustment within inherently stressful environments (e.g., combat platforms and operations) may well necessitate the continued development of research-based technological procedures for maximizing the probability of effective and successful functioning at all levels of personnel participation (Cheston and Winter, 1980). The present study, for example, along with previous experiments in this series, showed that an aversive motivational condition, despite its initial capacity to maintain effective performance, later produced serious undesirable side-effects that were realistically similar to those observed aboard the last Skylab mission, an exemplar of a type of "team"-oriented mission. Although the conditions provoking such side-effects were likely different between these disparate observational circumstances and the physical properties of the aversive stimuli perhaps impossible to specify, it would indeed seem prudent to emphasize similarity in outcomes especially in light of the long-term sequelae of allowing such side-effects to persist unchecked. A further functional analysis of such conditions with a view toward the identification of critical causal relationships would seem to be of obvious

benefit to microsociety and team scenario designers who could rationally eliminate potentially provocative circumstances without compromising the accomplishment of a given mission.

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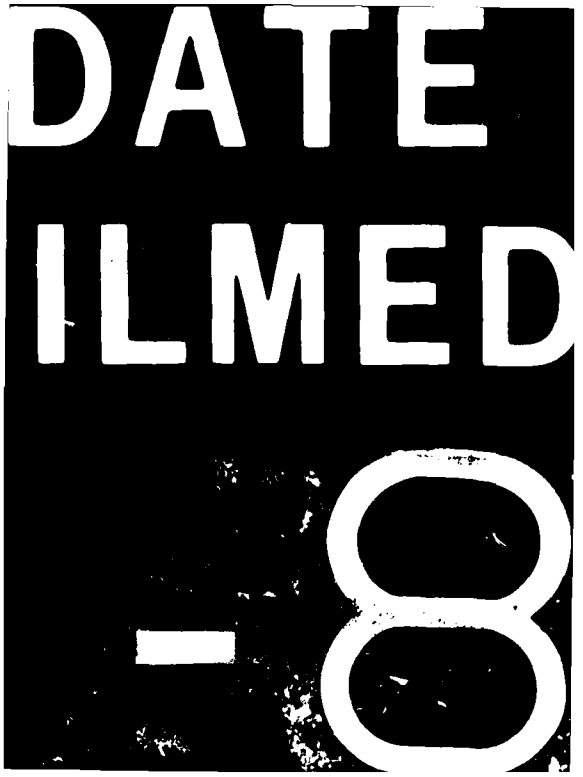
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